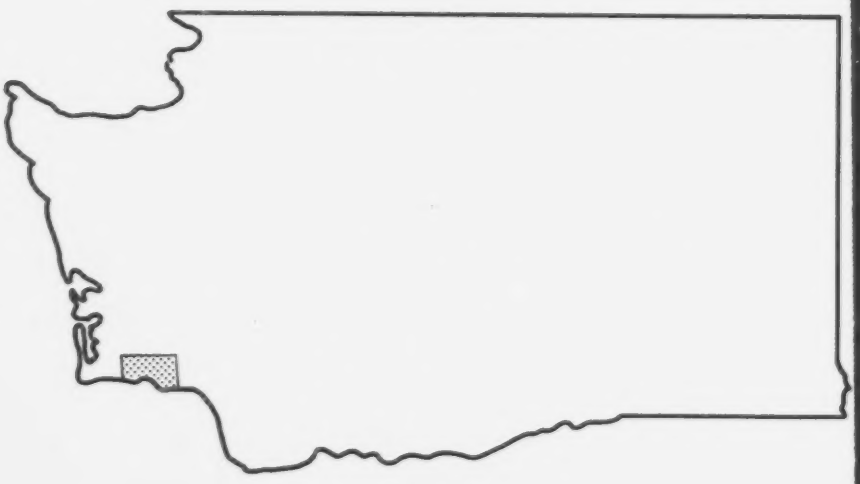
FLOOD INSURANCE STUDY

WAHKIAKUM COUNTY, WASHINGTON
UNINCORPORATED AREAS



SEPTEMBER 28, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 530193

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. The Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	1
2.0	AREA STUDIED	2
	2.1 Scope of Study	2
	2.2 Community Description	2
	2.3 Principal Flood Problems	5
	2.4 Flood Protection Measures	9
3.0	ENGINEERING METHODS	10
	3.1 Hydrologic Analyses	11
	3.2 Hydraulic Analyses	11
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	15
	4.1 Floodplain Boundaries	15
	4.2 Floodways	16
5.0	INSURANCE APPLICATION	18
6.0	FLOOD INSURANCE RATE MAP	19
7.0	OTHER STUDIES	19
8.0	LOCATION OF DATA	20
9.0	BIBLIOGRAPHY AND REFERENCES	20

TABLE OF CONTENTS (Cont'd)

Page

FIGURES

Figure 1 - Vicinity Map 3
Figure 2 - Columbia River - June 1948 Flood Event, Looking NW at Upstream End of Inundated Puget Island 6
Figure 3 - Looking NW Across Break in Dike at Southwest (Upper) End of Puget Island, June 9, 1948 7
Figure 4 - Grays River Covered Bridge, December 2, 1977, Flood . . . 8
Figure 5 - Floodway Schematic 18

TABLES

Table 1 - Summary of Columbia River Floods 9
Table 2 - Summary of Discharges 12
Table 3 - Summary of Flood Elevations 13
Table 4 - Floodway Data Table 17

EXHIBITS

Exhibit 1 - Flood Profiles

Columbia River	Panels 01P-03P
Elochoman River	Panels 04P-05P

Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

Exhibit 3 - Elevation Reference Marks

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Wahkiakum County, Washington, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Portland District, the study contractor, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 29. This study was completed in February 1985.

1.3 Coordination

A pre-contract coordination meeting was held on July 25, 1983, at the courthouse in the Town of Cathlamet. The meeting was attended by officials from Wahkiakum County and the Town of Cathlamet, and representatives from FEMA and the study contractor. The purpose of the meeting was to inform the communities on their status in the flood insurance program, to gather all available pertinent data on flooding in the community, and to reach an agreement on the areas to be studied. Also discussed at the meeting were flood hazards and possible locations of high water marks.

On November 2, 1989, the results of the study were reviewed at a final community coordination meeting attended by representatives of FEMA, the study contractor, and the community. The study was acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Wahkiakum County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

The Columbia River from river mile 33 to the eastern boundary of Wahkiakum County at river mile 51.6 and the Elochoman River from its mouth to river mile 4.5 were studied by detailed methods. That reach of the Columbia River includes the 1.4 mile reach of Cathlamet Channel.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through February 1991.

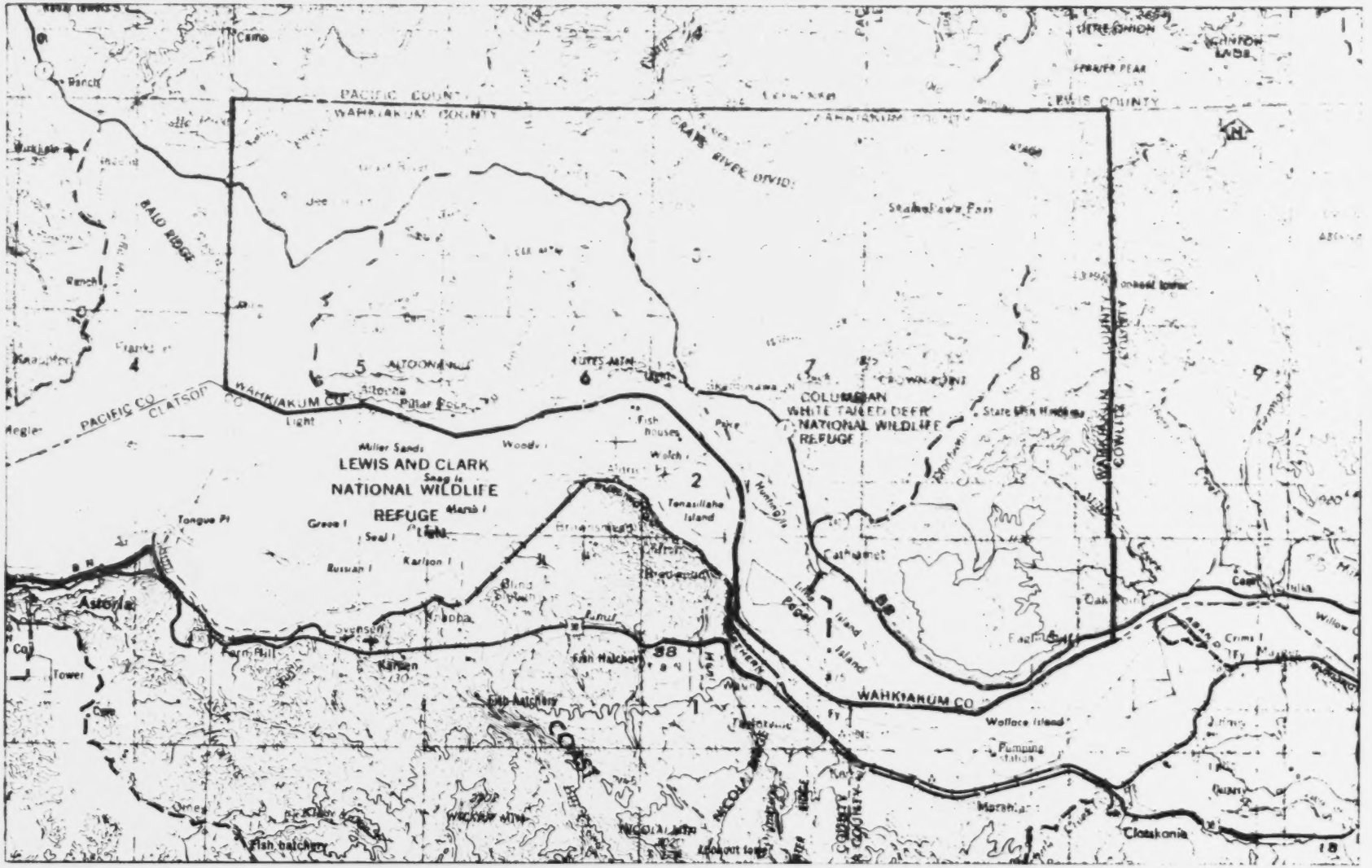
Approximate methods were used to study the Elochoman River from river mile 4.5 to river mile 8.0, Grays River from river mile 7.1 to river mile 11.6, Skamokawa Creek from its mouth to river mile 4.9, and Wilson Creek from its mouth to river mile 5.4. Birnie Creek from its mouth to approximately 800 feet upstream of State Highway 4 was studied by approximate methods. Only the flood hazards affecting Wahkiakum County have been illustrated in this study.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the community.

2.2 Community Description

Wahkiakum County is located in the southwestern corner of Washington State, on the north bank of the Columbia River where it cuts through the Coast Range. It is bordered on the west and northwest by Pacific County, the northeast by Lewis County, the east by Cowlitz County, and the south by the State of Oregon. Wahkiakum County, formerly part of Lewis County, was established in 1854 by the Washington Territorial government. Its name is an Indian word meaning "tall timber" (Reference 1).

The county was first settled in 1846 by James Birnie, a long time employee of the Hudson Bay Company, and his family, when the company sent him to operate a store built for trading purposes. In 1850, Mr. Birnie filed a donation land claim which covered the entire townsite of Cathlamet, which he named after the local Indian tribe (Reference 2). From that time on settlers have found transportation to populated centers to be one of their foremost problems. Steamboat service on the Columbia was always irregular, so residents of the county volunteered their services over the years to build roads which are very limited even today. In the 1930's, ferry services at Puget Island at last permitted county


PACIFIC COUNTY
WAHKIAKUM COUNTY
LEWIS COUNTY
GRAYS RIVER DIVIDE
BALD RIDGE
PACIFIC CO
CLATSOP CO
WAHKIAKUM CO
LEWIS AND CLARK
NATIONAL WILDLIFE
REFUGE
COLUMBIAN
WHITE TAILED DEER
NATIONAL WILDLIFE
REFUGE
Astoria
Tongue Pt
Tenasillahe Island
Karlson I
Russian I
Seal I
Grass I
Marsh I
Miller Sands
Pillar Rock
Light
Fish houses
Pike
Welch
Woody I
Little Pearl Island
Pearl Island
Wallace Island
Pumping station
Marshland
Clatskonie
Fish hatchery
COAST
RANGE
WICKIUP MTN
NICOLAI MTN
Lookout tower
Farm Hill
Tower
Cem
Camp
Ranch
Seaholm Farm
Crims I
Willow Grove
Oak Point
Farm
Fy
Ferry
Mooring
Quarry
Tank
Pumping station
Fish Hatchery
Old Hatchery
Creek
Light
Tower
Cem
Ranch
Camp
Fish hatchery
Lookout tower
Marsh
Island
Pearl
Little Pearl
Wallace Island
Tenasillahe Island
Karlson I
Russian I
Seal I
Grass I
Marsh I
Miller Sands
Pillar Rock
Light
Fish houses
Pike
Welch
Woody I
Tongue Pt
Astoria
Farm Hill

residents easy access to the metropolitan area of Portland, Oregon, via U.S. Highway 30, which follows the Columbia River along its southern bank (Reference 1).

The county has an area of 260.7 square miles and a population of 3,800 people (1984). It has a fairly mild climate with mild, wet winters and warm, dry summers. The average annual precipitation for the community of Grays River in northwestern Wahkiakum County is over 111 inches (Reference 1), while the average for the area of Cathlamet is approximately 50 inches with 65 percent falling during the 5 month period from November to March (Reference 3). The average temperature of the Town of Cathlamet ranges from 38°F in January to 64°F in July. The climate of Cathlamet is similar to that of the rest of the county, including limited rainfall in the summer, but due to its location on the Columbia River where it cuts through the Coast Mountain Range, moist air prevails throughout most of the year.

The largest and only incorporated community is the Town of Cathlamet, which is the county seat (Reference 2). It is located at the confluence of Birnie Creek with the Cathlamet Channel of the Columbia River in the southeastern part of Wahkiakum County. The town is located on the Columbia River where the channel separates around Puget and Little Islands approximately 30 miles west of Longview, Washington, and approximately 75 miles northwest of Portland, Oregon, via Interstate Highway 5 and State Highway 4. The main waterway for navigation is the south channel along the Oregon shore of the Columbia River. On January 17, 1907, Cathlamet was incorporated with a population of 350. The population had increased to 647 by 1970 but dropped to 594 by 1980. In 1984, the population was estimated to be 630 (Reference 4).

The economy of Wahkiakum County is based on agriculture, logging, and commercial gillnet fishing in the Columbia River. There are no factories. Some fish buying takes place during gill-netting season. A commercial fish cannery at Cathlamet provided significant employment until its closure in 1929. Fish canneries at Altoona and Pillar Rock closed in the 1950's. The county has depended on forest products and dairying as its primary economic pursuits in recent years. The economic character of Cathlamet is based on its being the commercial, retail, and service center and county seat of Wahkiakum County. The economic activity of the town today is devoted wholly to retail and service functions.

The historic and natural attributes of Wahkiakum County are a significant part of the community's character. The old Hudson Bay Company house built by James Birnie in 1860 which is on the State register of historic places, and the displays at the Wahkiakum County Historical Museum (both in Cathlamet) provide visual links to the past (Reference 5). The forested hills and the broad Columbia River provide the natural setting. From the eastern side of Grays Bay upstream to Skamokawa and then from Cathlamet upstream to the eastern county boundary, the north shore of the Columbia River is steep with many bluffs and cliffs. Some rise over 1,000

feet to hilltops within short distances of the river. The only significant breaks in the line of bluffs is the Grays - Deep River estuary and the Skamokawa Creek - Elochoman River estuary. The Columbia River Basin is nationally known for fishing opportunities. Chinook and coho salmon, sturgeon, steelhead, and trout are fished. Deer, elk, and other wildlife are commonly sighted in the county.

The soils in Wahkiakum County vary from soft organic silt around the Cathlamet Boat Basin and at the mouths of the Grays and Elochoman Rivers to sandy silts and silty sands over most of the rest of the floodplains including Puget Sound and Little and Hunting Islands to decomposed sandstone and basalt over the rest of the area. The geological formations under Cathlamet consist of a firm sandstone strata more than 40 feet thick underlain by basalt bedrock and also topped by a flow of basalt. These basalt and sandstone strata are exposed in a 70-foot bluff on the northeastern side of the boat basin. Upstream, on the southeastern end of town, even the underlying basalt bedrock is exposed and makes up part of the cliffs, which rise to an elevation of 150 feet above the river level within 50 feet of the water's edge and to more than 200 feet above the river level within 250 feet of the water's edge (Reference 3).

2.3 Principal Flood Problems

The Columbia, Elochoman, and Grays Rivers and Skamokawa and Wilson Creeks are the principal sources of flooding in Wahkiakum County.

The Columbia River upstream of Cathlamet drains an area of approximately 257,000 square miles. The past history of flooding on the Columbia River indicates that flooding is primarily caused by heavy spring runoff from snow melt in the eastern part of the basin. Severe flooding can also develop in the fall and winter from intense rainfall augmented by snowmelt when the soil is near saturation over the western part of the basin. Damaging spring and summer floods may occur any time between mid May and late June, and may last 2 to 3 months. Fall and winter floods are infrequent and have durations of only a few days.

At least four major floods have occurred in the last 40 years, during the months of June 1948, June 1950, June 1956, and December 1964. The worst flooding to occur on the Columbia River occurred in June 1894. Figures 2 and 3 show the June 1948 Columbia River flood in aerial views of Puget Island. Figure 4 shows the December 1977 flood on Grays River.

The seven largest floods known to have occurred on the Columbia River, the stages reached (Columbia River Datum (CRD)) and flood elevations (National Geodetic Vertical Datum (NGVD)) at Wauna gage (river mile 41.8) near Cathlamet are shown in Table 1 (Reference 6); also shown are peak discharges at The Dalles, Oregon (river mile 119), the nearest gaging station with a reliable discharge measurement, and the approximate recurrence interval (Reference 7).

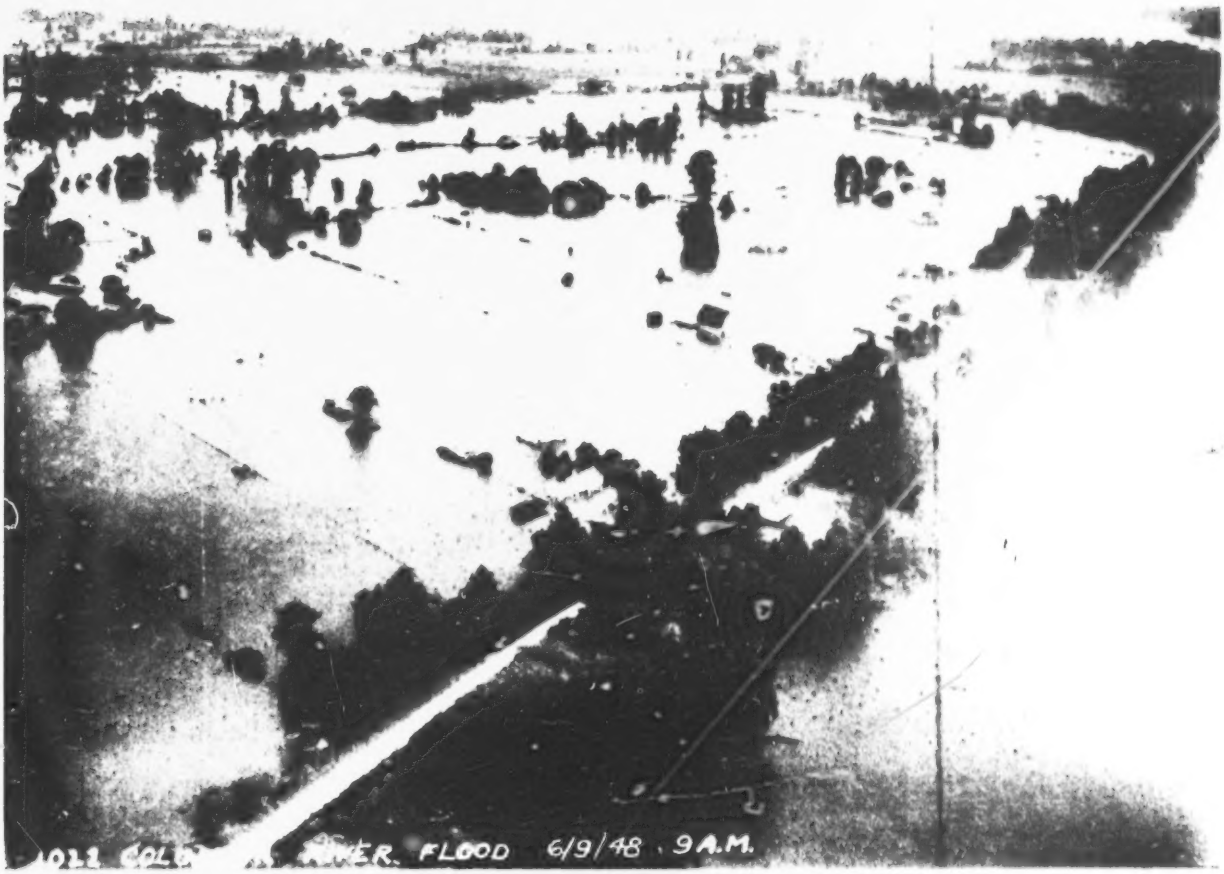


Figure 2. Columbia River June 1948 flood at Puget Island, Washington, looking NW across inundated W.C.C.D.D.#1.

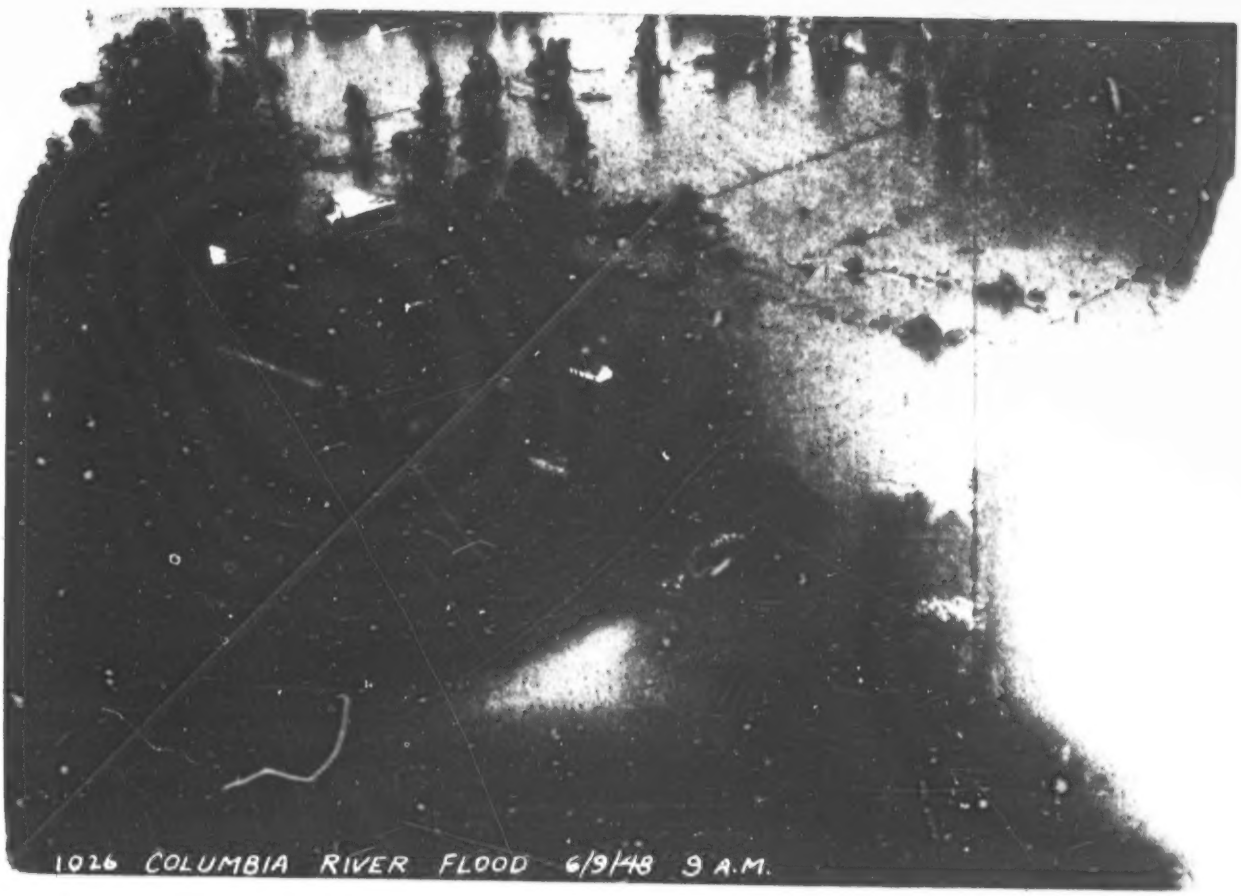


Figure 3. Puget Island, looking NW across break in levee at upper end. Columbia River, June 9, 1948, flood.

Figure 4. Grays River covered bridge, December 2, 1977, flood.

Table 1. Columbia River Floods

Flood	Maximum Stage and Elevation at river mile 41.8 near Cathlamet Stage (feet CRD)	Elevation (feet NGVD)	Peak Discharge At The Dalles (cfs)	Approximate Recurrence Interval Years
June 1894	15.0	13.2	1,240,000	30
June 1948	12.8	11.0	1,010,000	48
June 1876	11.9	10.1	958,000	18
June 1956	11.7	9.9	823,000**	17
December 1933	11.7	9.9	*	*
December 1964	11.5	9.7	*	*
June 1950	11.4	9.6	744,000***	9

* Not applicable, peak discharge at The Dalles not representative of large winter floods on Columbia River below Vancouver, Washington.
** Regulated flow, unregulated = 940,000 cubic feet per second (cfs)
*** Regulated flow, unregulated = 823,000 cfs

Flooding from the Elochoman and Grays Rivers and Birnie, Skamokawa, and Wilson Creeks is generally caused by rainfall in the winter, the period of greatest local storm activity. Floods rise quickly following a heavy rainstorm and usually last less than 2 days on the rivers and larger creeks and 2 hours on Birnie Creek.

The largest flood on these rivers in the last 13 years occurred in December 1977. Heavy rains at that time caused considerable shallow flooding in the Town of Grays River and in the Grays River floodplain. Some shallow flooding was observed in the Elochoman River floodplain.

Since there is no stream gage on Birnie Creek, flooding is not well documented; however, according to local officials, no large floods on Birnie Creek have occurred in historical times. The small contributing drainage area of less than 2 square miles does not produce large streamflows and a well-armored and clean channel through portions of the study reach also reduces possible future flood levels.

2.4 Flood Protection Measures

More than 50 flood control storage projects on the Columbia River and its tributaries have a significant impact on flood peaks. The Columbia River flood control system consists of a series of flood control storage reservoirs in both the U.S. and Canada. There are 22 major reservoirs in the Columbia River Basin upstream of the Williamette River, with a total flood control storage volume of approximately 43.6 million acre-feet (Reference 8).

In addition, there are 11 major flood control reservoirs in the Williamette River Basin, with approximately 1.7 million acre-feet of flood storage (Reference 8). Mossy Rock reservoir on the Cowlitz River also contributes 360,000 acre-feet of flood control storage upstream of Cathlamet (Reference 9). The combined total of flood control storage available on the Columbia River upstream of Cathlamet is approximately 45.7 million acre-feet.

The areas of Puget and Little Islands are included in the Wahkiakum County Consolidated Diking District No. 1 and are protected from 100-year flooding on the Columbia River by levees of the district. Flood Profiles for the Columbia River were revised in 1979, concurrent with completion of levee improvements, and reduced available design freeboard from 1.6 to 2.3 feet. A ground survey made in November 1985 determined that the existing levee freeboard ranged from a minimum of 1.1 to over 3 feet. Based on the ground survey, the observations of an engineering survey team, and a detailed analysis of the flood threat and the levee configuration, it has been determined that the freeboard of the levees surrounding the islands is adequate to provide 100-year protection.

The determination that the levee freeboard is adequate is based on the concept of "equivalency." While the levee does not have the 3 feet of freeboard recommended by FEMA regulations, the physical features of the levees allow equivalent protection. The levees surrounding the islands are very wide, low-head embankments, with a paved road on the crest. The levees have relatively flat backslopes and are afforded adequate wave protection by the berms, vegetation, and structures riverward of the levee.

There are no certified or proposed flood-control structures on any of the other streams in these areas. There is a dike district near the mouth of the Elochoman River; however, the levee is not certified as providing 100-year protection. Some other areas have earth berms near the streambanks, but these may wash out rapidly in a major flood.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or

exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

There are no stream gage stations in Skamokawa, Wilson, and Birnie Creeks. The frequency discharges were developed in the regional analysis presented in "Magnitude and Frequency of Floods in Washington," U.S. Geological Survey Open-File Report 79-553, dated 1979 (Reference 10). The frequency discharges developed by this procedure were checked by a Meyer's rating curve for the 100-year event prepared for northwest Oregon.

Peak discharge-drainage area relationships for the streams are shown in Table 2.

The stage discharge relationship for the Columbia River near Cathlamet is influenced by ocean tides. Thus, flood frequencies are more reliably determined for stages than for discharges, and combined probability stage-frequency curves were developed for several locations on the Columbia River, including one at river mile 41.8 at Wauna, Oregon, across the Columbia River (and Puget Island) from Cathlamet. These curves were based on the statistical combination of stage-frequency curves for fall-winter floods and spring-summer floods and used to produce combined probability stage-frequency water-surface profiles (Reference 11). Those profiles were prepared for the Flood Insurance Studies for Multnomah County, Oregon; Clark County, Washington (References 7 and 12); and other communities. Cathlamet Channel elevations were derived by a correlation process connecting the elevation of the Columbia River upstream and downstream of Puget and Little Islands. Elevations for floods of the selected recurrence intervals on the Columbia River and Cathlamet Channel are shown in Table 3.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Table 2. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Elochoman River					
At mouth	73.3	7,830	9,910	10,700	12,600
Upstream of Nelson Creek	68.9	7,530	9,540	10,300	12,100
At gaging station	65.8	**	**	10,100	**
Downstream of Beaver Creek	64.9	**	**	10,000	**
Upstream of Beaver Creek	56.9	**	**	9,400	**
Upstream end of approximate study	53.3	**	**	9,270	**
Grays River					
Downstream end of approximate study	110.3	**	**	24,600	**
Upstream of Hull Creek	97.4	**	**	22,200	**
Upstream end of approximate study	92.5	**	**	21,300	**
Skamokawa Creek					
At mouth	50.6	**	**	8,820	**
Downstream of Wilson Creek	49.1	**	**	8,730	**
Upstream of Wilson Creek	35.0	**	**	6,990	**
Upstream of Falk Creek	30.4	**	**	6,610	**
Downstream of Left Fork	15.9	**	**	4,290	**
Upstream of Left Fork	10.2	**	**	3,210	**
Wilson Creek					
At mouth	14.1	**	**	3,630	**
Downstream of Bell Canyon	13.6	**	**	3,540	**
Upstream of Bell Canyon	11.9	**	**	3,250	**
Downstream of Unnamed Tributary	8.7	**	**	2,690	**
Upstream Unnamed Tributary	7.1	**	**	2,340	**
Upstream end of approximate study	5.4	**	**	1,980	**
Birnie Creek					
At mouth	1.6	**	**	290	**
River mile 0.5 (about 800 feet upstream of State Highway 4)	1.35	**	**	250	**

**Not Determined

Table 3. Summary of Elevations

Flooding Source and Location	Drainage Area (Square Miles)	Flood Elevations (feet NGVD) 10-Year	50-Year	100-Year	500-Year
Columbia River near Cathlamet, at River mile 41.8	257,000	9.7	10.5	10.9	11.8

Hydraulic analyses for the detailed study on the Elochoman River were performed using the COE HEC-2 step-backwater computer program (Reference 13). Cross sections for the lower Elochoman River came from survey data obtained from the COE. Overbank cross section data near bridges were taken from an orthophoto topographic map prepared from photography dated July 7, 1984 (Reference 14). All bridges and culverts were field surveyed by COE personnel to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness values (Manning's "n") for the channel and overbanks were first estimated from field observation. The "n" values in the right overbank area were adjusted to account for the reduction of effective flow area due to the levee. The final calibrated "n" values in the lower Elochoman River were 0.045 for the channel and from 0.07 to 0.15 for the overbanks. To account for particularly ineffective flow areas due to levees and thick underbrush, "n" values of 0.045 to 0.140 were used.

The starting water-surface elevation for the Elochoman River was computed from a given energy slope. The slope was estimated based on energy slopes in the shallow sloping stream reach from river mile 1.0 to river mile 1.8 and was adjusted for downstream conditions in the Columbia River. Flood profiles were drawn showing calculated water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Columbia River flood profiles for selected recurrence intervals were plotted directly from the combined probability stage-frequency curves previously described. Cathlamet Channel flood elevations were derived by using elevations from Columbia River profiles at the upper and lower ends of Puget Island, correlating those points with Cathlamet Channel river miles and connecting them by straight lines.

No cross sections or computer model were developed for the Columbia River.

All elevations are referenced to the NGVD of 1929. Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

Analyses were carried out to provide estimates of the 100-year flooded-area outline on 18.8 miles of stream in Wahkiakum County. Approximate studies were performed for the following reaches:

Elochoman River	(river mile 4.5 to river mile 8.0)
Grays River	(river mile 7.1 to river mile 11.6)
Skamokawa Creek	(mouth to river mile 4.9)
Wilson Creek	(mouth to river mile 5.4)
Birnie Creek	(mouth to river mile 0.5)

Hydraulic analyses were performed on cross sections spaced approximately 1 mile apart in these reaches. No vertical control was maintained. Each cross section was established based on a local datum set in the field at each site. At each cross section the 100-year flood height was computed by slope-area analysis. The 100-year floodplain limits were then drawn between cross sections based on field observation and engineering judgment. The roughness factor (Manning's "n") varied from 0.045 in the channel to 0.10 in densely wooded overbanks. The energy slope required to compute flood height at each cross section was determined from water-surface differences surveyed in the field.

Approximate flooding for Birnie Creek was developed using hand computations. These include a culvert analysis for the four road fills that cross Birnie Creek through the study reach and also normal-depth hand computations for several Birnie Creek cross sections. Cross section data was obtained from Washington State Highway Department maps for Cathlamet and vicinity, dated 1963 (Reference 15). Culvert data for the four road crossings were obtained in the field by COE personnel.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

In order to provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management measures. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood

elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (References 15 and 16).

For the streams studied by approximate methods, the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum FEMA standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 4). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 5.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY[2]	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Elochoman River								
A	1,056	2,000	9,220	1.2	10.4	9.5	10.0	0.5
B	3,436	2,400	2,380	1.1	10.4	10.2	11.0	0.8
C	4,756	1,800	7,510	1.4	10.5	10.5	11.4	0.9
D	5,041	2,000	9,950	1.1	10.9	10.9	11.8	0.9
E	7,541	2,000	11,820	0.9	11.5	11.5	12.5	1.0
F	9,341	2,255	15,260	0.7	11.9	11.9	12.9	1.0
G	11,341	900	4,370	2.4	12.4	12.4	13.4	1.0
H	11,491	870	2,950	3.5	12.5	12.5	13.5	1.0
I	11,671	870	4,520	2.3	13.1	13.1	14.1	1.0
J	12,921	560	2,830	3.6	13.7	13.7	14.7	1.0
K	14,921	326	2,160	4.8	16.9	16.9	17.6	0.7
L	16,891	120	1,870	5.5	19.1	19.1	20.0	0.9
M	19,291	121	1,090	9.4	22.9	22.9	23.7	0.8
N	21,271	152	1,810	5.7	28.8	28.8	29.5	0.7
O	22,271	100	1,270	8.1	30.2	30.2	31.1	0.9
P	22,786	137	1,680	6.1	33.3	33.3	33.5	0.2
Q	23,806	114	1,280	8.0	35.3	35.3	36.1	0.8

[1]Feet upstream of confluence with Elochoman Slough
[2]Datum of 1929, for NGVD add 0.4 foot

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAHKIAKUM COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ELOCHOMAN RIVER

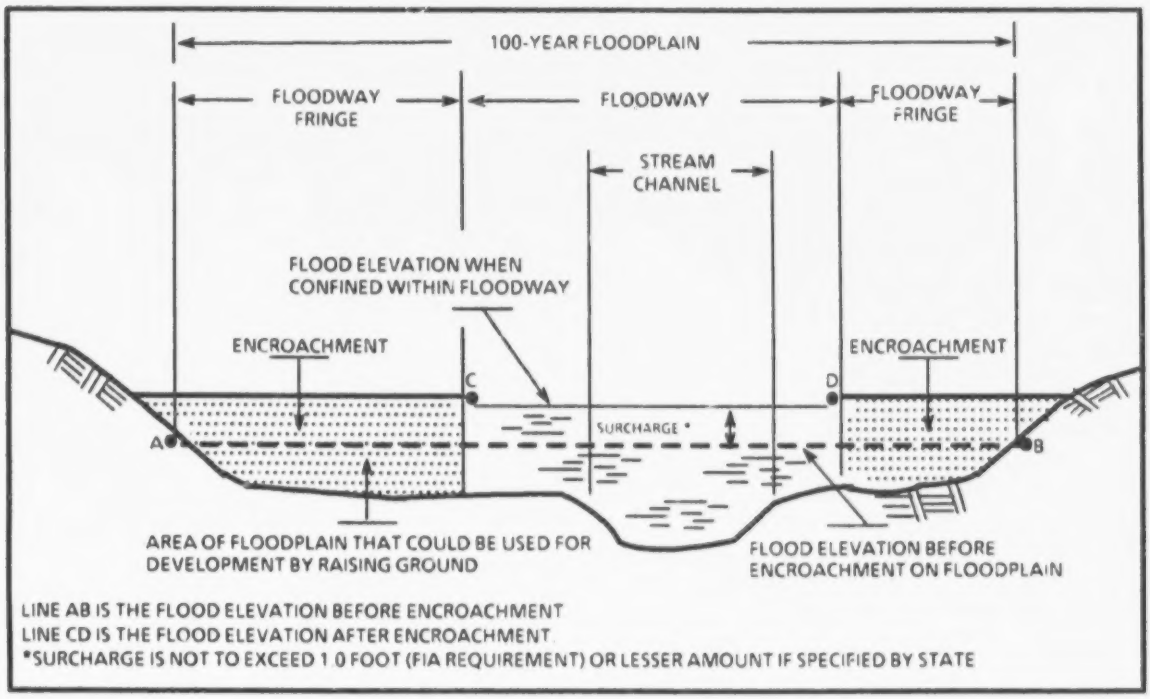

100-YEAR FLOODPLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE *
AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 5. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A:

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE:

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X:

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Flood Hazard Boundary Maps were prepared for selected portions of the county (Reference 17). However, this study represents a more detailed analysis.

A Flood Insurance Study was prepared for the Town of Cathlamet, dated September 1986 (Reference 18). This study incorporates the results of that study.

A report prepared for the Wahkiakum County Board of Commissioners by a consulting engineering firm in 1975, entitled Flood Damage Prevention Plan, presents a plan for implementation of flood damage reduction measures; however, it does not delineate flooded areas in the immediate vicinity of Cathlamet (Reference 19).

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Chief, Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Office of the Governor and Office of the Secretary of State, Washington State Yearbook, 1985.

2. Lulu B. Heron, "Cathlamet in Early Days," 1933, republished by Wahkiakum County Eagle in Historical Wahkiakum County, Special Edition, dated May 3, 1973.

3. U.S. Department of the Army, Corps of Engineers, Portland District, Cathlamet Moorage Basin, Elokomin Slough, Section 107, "Detailed Project Report," June 13, 1966.

4. Information supplied by Ms. Vivian Olson, Cathlamet Town Clerk.

5. Wahkiakum County Eagle, Historical Wahkiakum County, Special Edition, dated May 3, 1973.

6. U.S. Department of the Army, Corps of Engineers, Portland District, "Columbia River Flood Profiles", drawing number CL-03-116, revised April 1973.

7. Federal Emergency Management Agency, Flood Insurance Study, Multnomah County, Oregon, December 15, 1981.

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11. U.S. Department of the Army, Corps of Engineers, Portland District, Columbia River, Combined Probability Flood Frequency Profiles, Mouth to Bonneville Dam, October 1979.

12. Federal Emergency Management Agency, Flood Insurance Study, Clark County, Washington, October 16, 1987.

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14. U.S. Department of the Army, Corps of Engineers, Portland District, Topographic Survey of the Elochoman River, Vicinity of Cathlamet, Washington, Scale 1:400 feet, Contour Interval 4 feet, photography dated July 7, 1984.

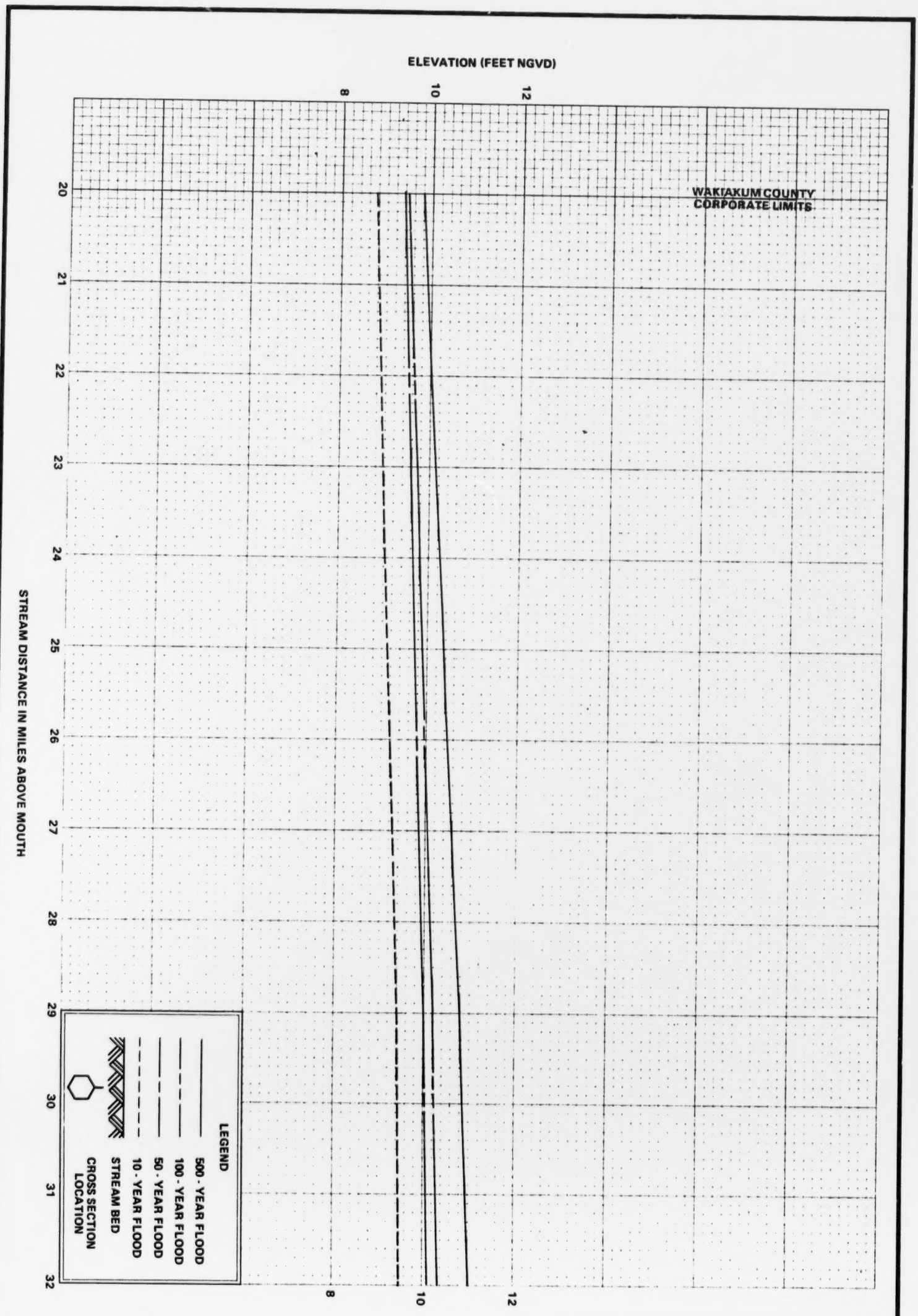
15. Washington State Department of Highways, "Topographic Map D-2, Cathlamet Vicinity, Wahkiakum County, Primary State Highway No. 12," Scale 1:200 feet, Contour Interval 5 feet, approximate date 1963.

16. U.S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500: Cathlamet, Oregon-Washington, Contour Interval 50 feet (1952); Grays River, Oregon, Contour Interval 50 feet (1955); Skamokawa, Oregon, Contour Interval 80 feet (1953).

17. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Wahkiakum County, Washington, February 21, 1975.

18. Federal Emergency Management Agency, Flood Insurance Study, Town of Cathlamet, Washington, September 29, 1986.

19. VTN Washington, Inc., Flood Damage Prevention Plan, Wahkiakum County, April 1975.



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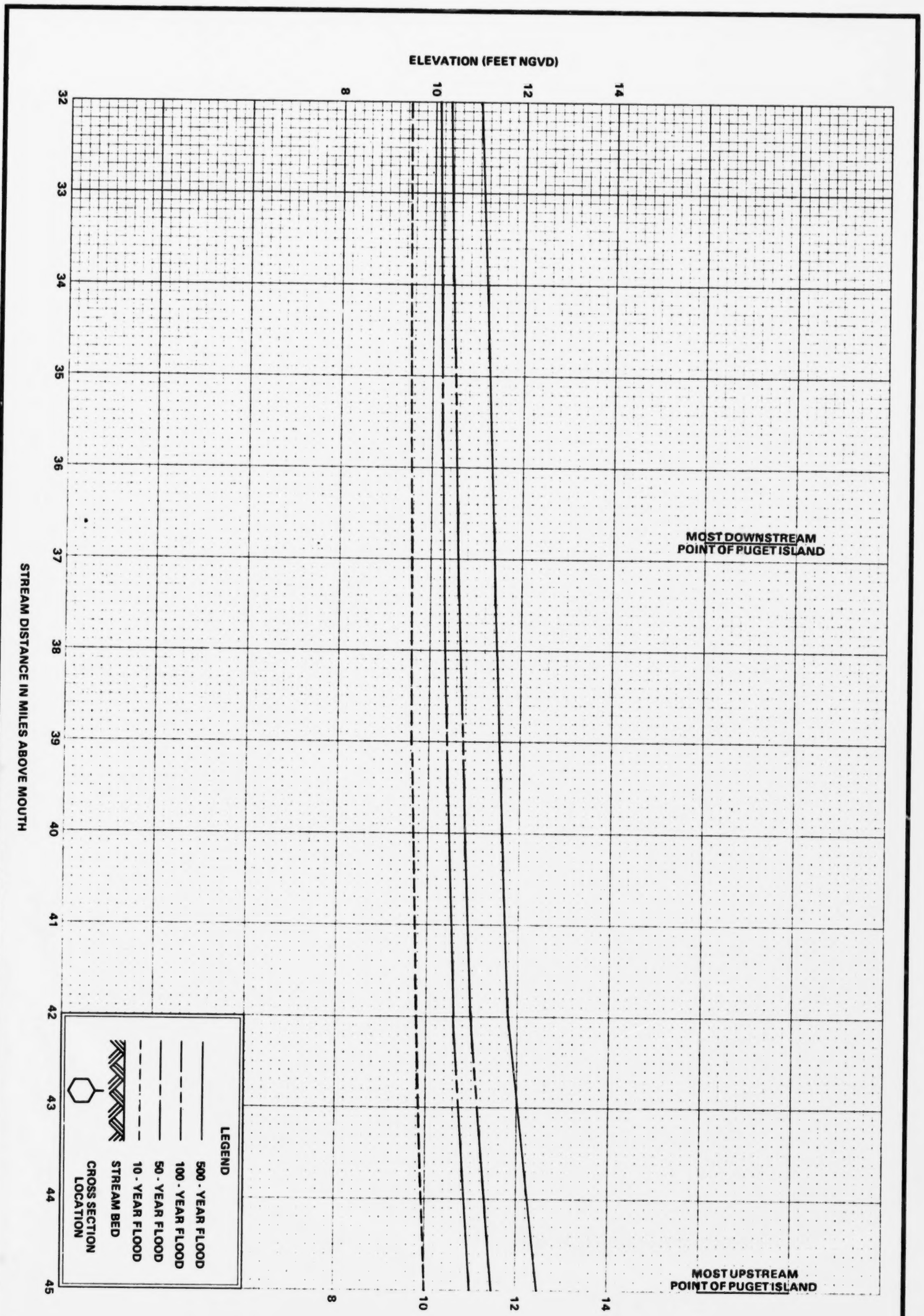


23

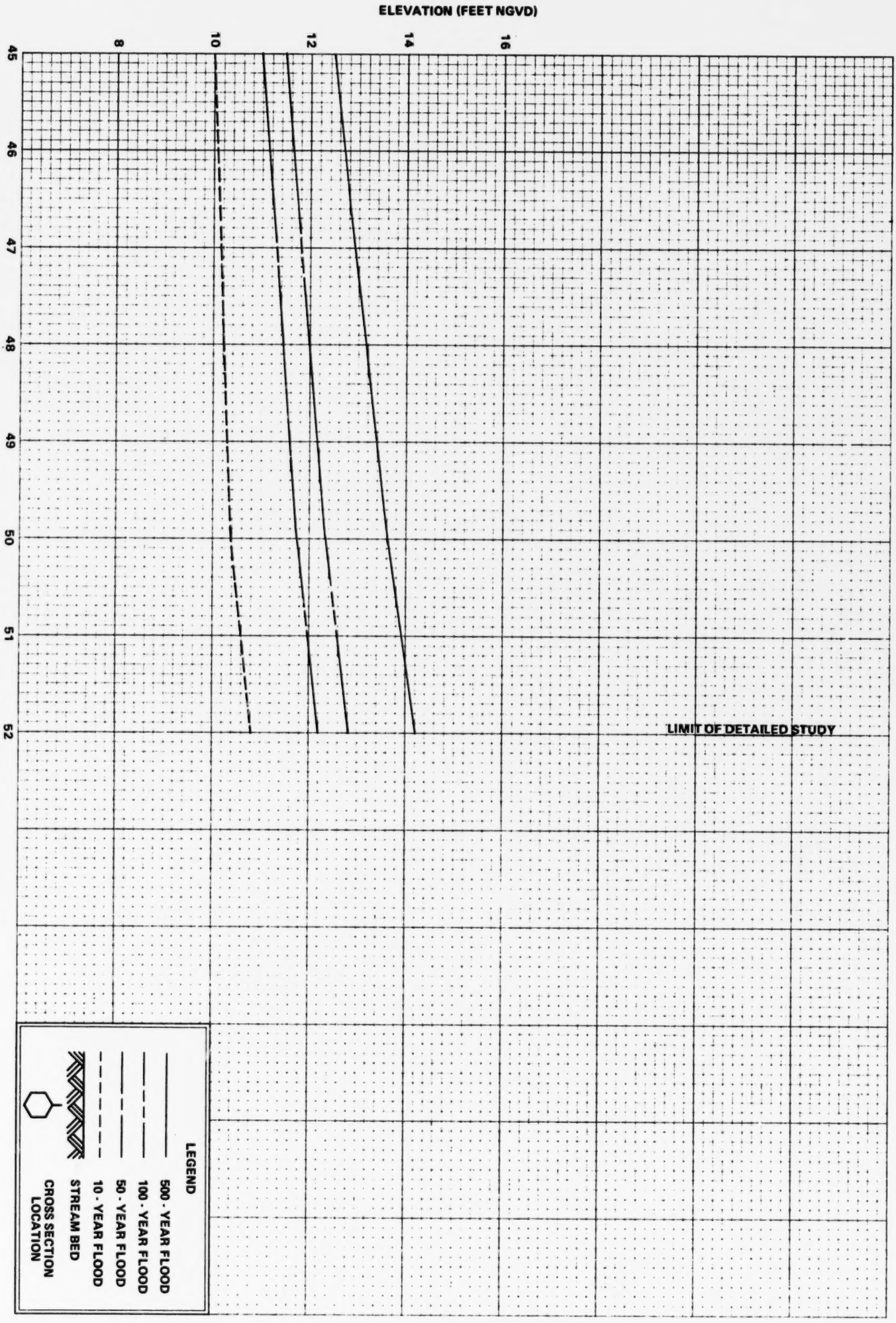
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAKIAKUM COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

COLUMBIA RIVER



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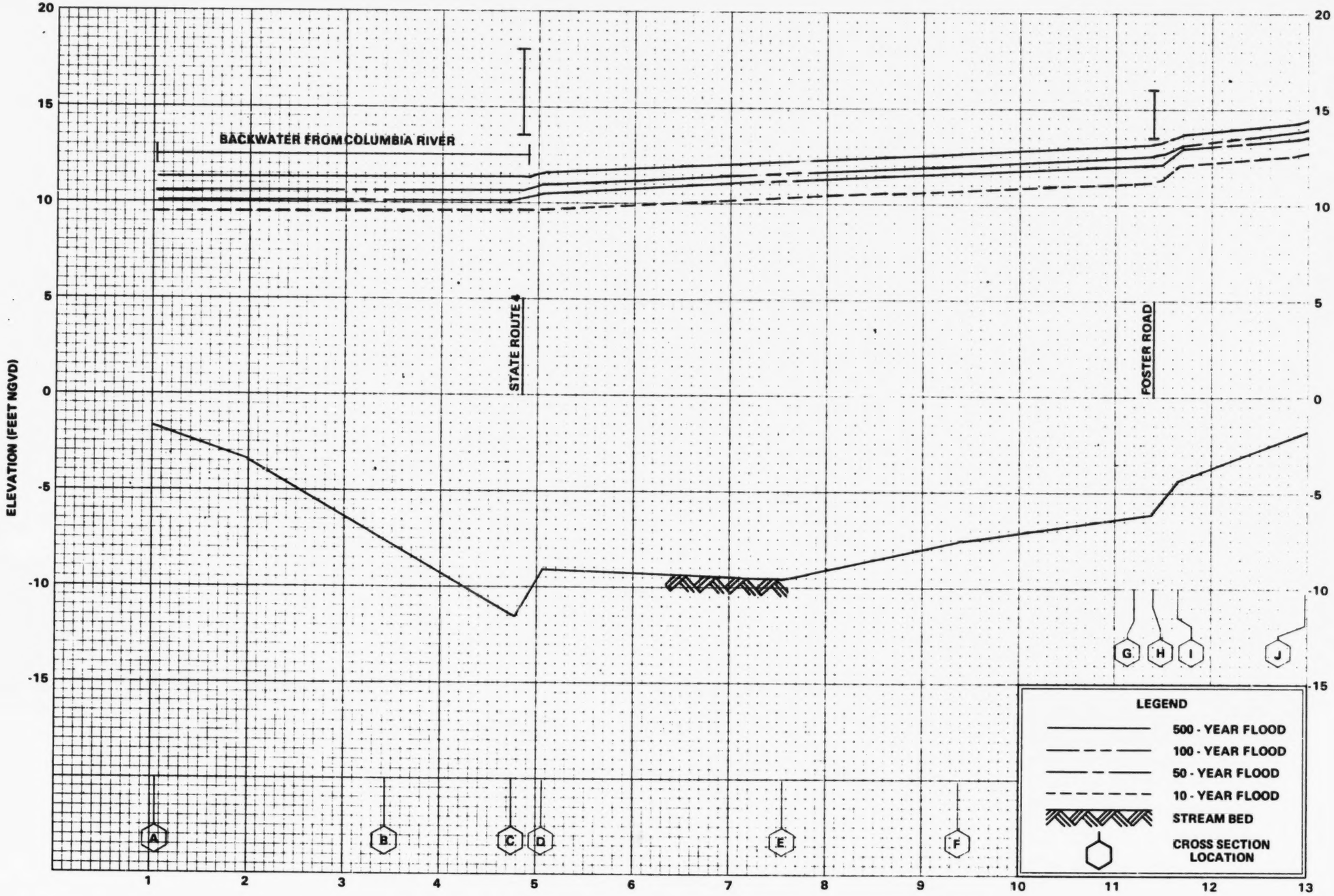


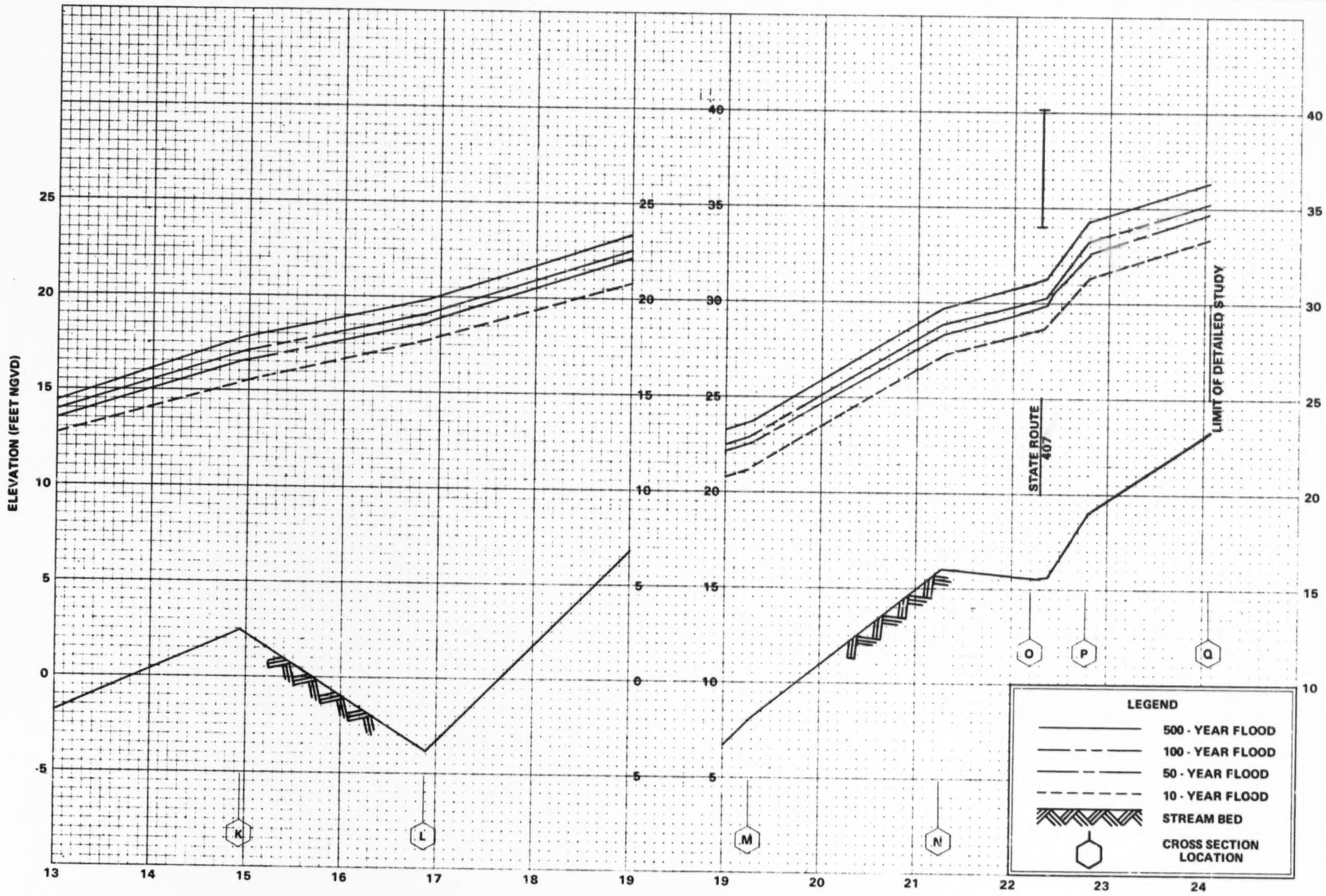
FLOOD PROFILES

ELOCHOMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAKIAKUM COUNTY, WA
(UNINCORPORATED AREAS)

04P



FLOOD PROFILES

ELOCHOMAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAKIAKUM COUNTY, WA

(UNINCORPORATED AREAS)

05P

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 1	10.830	U.S. Coast and Geodetic Survey (USC&GS) standard disk, stamped "W 62 1934." About 5.7 miles west along State Highway 4 from the Lower Columbia Cooperative Dairy Association building at Grays River, in southeast quarter, Section 20, T10N, R8W, about 0.4 mile southeast of east end of drawbridge over Deep River, 25 feet southwest of southwest end of 2-room frame house, 7.4 feet southeast of west corner of yard fence, 47.5 feet east of centerline of highway, and set in top of a concrete post.
RM 2	22.802	USC&GS standard disk, stamped "X 62 1934." About 3.2 miles west along State Highway 4 from the Lower Columbian Cooperative Dairy Association building at Grays River, in southwest quarter, Section 22, T10N, R8W, about 600 feet northeast of Seal River Church, 85 feet west of southwest corner of a frame barn, 48 feet north of pedestrian gate to farmhouse, 28 feet southeast of centerline of highway, 4.2 feet southeast of a pole, and 1.4 feet northwest of right-of-way fence, and set in top of a concrete post.
RM 3	61.614	A U.S. Army Corps of Engineers (COE) standard triangulation station disk, stamped "A 317 1939." About 3.1 miles northwest along old State Highway 12C from the post office at Altoona, in the northeast quarter, Section 4, T9N, R8W, at the junction of Eden Valley Road, about 50 feet west of the junction, 30 feet southwest of a highway sign post, 25 feet west of the highway on the north end of turn-out area, near a witness post, and set in top of a concrete post.
RM 4	21.581	A COE standard triangulation station disk stamped "N 317 21 1939." At Skamokawa, on State Highway 4, at the southeast end of the concrete bridge over Skamokawa Creek, in the bridge sidewalk, and 1.4 feet west of the east end.

EXHIBIT 3 - ELEVATION REFERENCE MARKS (Cont'd)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 5	25.581	A COE standard disk, stamped "M 317 25 1939." At the grade school in the northwest part of Skamokawa, at the main entrance at the south side of the building, and in the west side of the concrete porch.
RM 6	12.15	On Puget Island at northern tip, in southeast quarter, Section 4, T8N, R6W, at traverse station 471+58, at western end of curve where W. Birnie Slough Road becomes Ostervold Road, 11 feet right (riverward) of centerline of asphalt road on top of levee, a boat spike and washer stamped WK 50, cemented in iron pipe, set in concrete 0.4 feet below surface (COE).
RM 7	19.311	USC&GS bench mark (BM) No. H-63. Approximately 4.1 miles northwest along old State Highway 12 (Risk Road) from the county courthouse at Cathlamet, 1934. 24.5 feet east of the centerline road, 20.0 feet north of mailbox to 190 Risk Road, 52 feet north and 7 feet southeast of Power Pole No. 263/36 at north edge of 190 Risk Road (Olmsted), 1.0 foot north of witness post, 0.1 foot above centerline road elevation.
RM 8	16.427	USC&GS BM No. W-202. Approximately 3.8 miles northwest along State Highway 4 from the county courthouse at Cathlamet, approximately 2.9 miles southeast along State Highway 4 from the Dock Hotel at Skamokawa, in northeast quarter, Section 22, T9N, R6W, 40 feet south of a driveway to a brick house, 24 feet south of the centerline of the highway, 6 feet north of a fence line, and 1 foot north of power transmission line pole. A standard disk, stamped "W 202 1941" set in top of a concrete post.
RM 9	13.543	USC&GS BM No. J-63, 1934. Approximately 2.0 miles northwest along old State Highway 12 (Foster Road) from the county courthouse at Cathlamet, approximately 0.2 mile southeast of the bridge over the Elochoman River. 13.5 feet west of the centerline road, 1.5 feet east of wood fence opposite north fence of wooden corral on east side of road, 46 feet north, 8.0 feet east of 20-inch DBH walnut tree, 94 feet north of Power Pole No. 201.

EXHIBIT 3 - ELEVATION REFERENCE MARKS (Cont'd)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 10	10.840	On Little Island in northwest quarter of southeast quarter, Section 11, T8N, R6W, at traverse station 158+88, approximately 120 feet southeast of the intersection of W. Little Island Road and the centerline of the Cathlamet Channel Bridge extended, 11 feet left (landward) of center line of asphalt W. Little Island Road on top of levee, a brass disk stamped "WL 19" in concrete monument, 0.5 foot below surface (COE).
RM 11	11.500	On Little Island in southwest quarter of southwest quarter, Section 12, T8N, R6W, at traverse station 125+97, approximately 350 feet southeast of intersection of State Highway 409 and E. Little Island Road, 9 feet right of centerline of asphalt E. Little Island Road, on top of levee, a brass disk stamped "WL 17" in concrete monument, 0.6 foot below surface (COE).
RM 12	10.220	On Little Island in southeast quarter of southwest quarter, Section 11, T8N, R6W, at traverse station 205+36, at outside (sloughward) of small "S" curve along Bernie Slough approximately 0.85 mile northwest of intersection of State Highway 409 and W. Little Island Road (south), 11 feet right (sloughward) of centerline of asphalt W. Little Island Road on top of levee, a boat spike and washer stamped "WL 26," cemented in iron pipe set in concrete monument, 0.9 foot below surface (COE).
RM 13	11.650	On Little Island northeast quarter of southeast quarter, Section 13, T8N, R6W, at traverse station 60+70 at upstream end of island, 15 feet right of centerline of asphalt E. Little Island Road, a brass disk stamped "WL 9" in concrete monument, 1.0 foot below surface (COE).
RM 14	11.280	On Puget Island in southwest quarter, Section 19, T8N, R5W, on E. Birnie Slough Road at traverse station 212+77, 13 feet left (landward) of centerline of asphalt road on top of levee, a boat spike and washer set in concrete monument 0.7 foot below surface and stamped "WK 19" (COE).

EXHIBIT 3 - ELEVATION REFERENCE MARKS (Cont'd)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 15	12.660	On Puget Island on Sunny Sands Road in northwest quarter, Section 30, T8N, R5W, at traverse station 157+73, 13 feet right (riverward) of centerline of asphalt road on top of levee, approximately 127 feet west of a 36-inch diameter CMP tide box through levee, a boat spike and washer cemented in iron pipe, set in concrete 0.6 foot below ground surface, stamped "WK 13" (COE).
RM 16	10.760	On Puget Island, on Sunny Sands Road in southeast quarter of northwest quarter, Section 25, T8N, R6W, at traverse station 119+11, 15 feet right (riverward) of centerline of asphalt road on top of levee, a boat spike and washer cemented in iron pipe, set in concrete. 0.7 foot below surface, and stamped "WK 11" (COE).
RM 17	14.114	In northwest quarter, Section 20, T8N, R5W, approximately 4.1 miles southeast along State Highway 4 from the county courthouse at Cathlamet, about 185 feet southeast of the center of a house, 48 feet northwest of the centerline of a private road leading northeast, approximately 70 feet northeast of the top of the bank of the Columbia River, 40 feet northeast of the centerline of the highway, and near a witness post painted "USBM." A standard disk, stamped "M 63 1934" and set in top of a concrete post about flush with the ground.
RM 18	20.942	In southwest quarter, Section 21, T8N, R5W approximately 5.2 miles southeast along State Highway 4 from the county courthouse at Cathlamet, at a cut and turnout on the north side of highway, 45 feet east of mile post 21, approximately 135 feet west of north end of concrete culvert 20-98, 30 feet north of centerline of the highway and near a witness post painted "USBM." A standard disk, stamped "R 202 1941" set in the top of a concrete post.

EXHIBIT 3 - ELEVATION REFERENCE MARKS (Cont'd)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 19	237.808	In northeast quarter, Section 27, T8N, R5W, approximately 6.75 miles southeast along State Highway 4 from the county courthouse at Cathlamet, at a cut on the summit of a hill with a turnout on the north side, 66 feet west of the south end of a concrete pipe culvert 19-50, 27 feet south of the centerline of the highway, near a witness post painted "USBM," on top of a bank, and approximately 2 feet higher than the highway. A standard disk, stamped "Q 202 1941" set in top of a concrete post.
RM 20	20.564	In Wahkiakum County, approximately 2.1 miles southwest along State Highway 4 from the store at Oak Point, Cowlitz County, about 550 feet southwest of the Wahkiakum-Cowlitz County line, 77 feet southwest of the southeast end of a concrete pipe culvert, 26.5 feet southeast of the centerline of the highway and near a witness post painted "USBM." A standard disk stamped "Q 63 1934" set in top of a concrete post.
RM 21	17.170	Set brass screw leaded into drill hole in top of wingwall of bridge abutment southwest corner of bridge over the Elochoman River on State Highway 12, Ocean Beach Highway.
RM 22	6.690	Set 2-inch diameter domed brass disk grouted into 2-inch diameter galvanized iron pipe 4 feet long driven into ground, disk is marked: ERM#4, 1984, AMCO. 25 feet north of the centerline of Risk Road, 28 feet west of centerline-centerline intersection of Risk Road and Nelson Creek Road, 1.5 feet west of Power Pole No. 31, 1.5 feet south of right-of-way fence.
RM 23	46.570	Set brass screw leaded into drill hole in concrete walk at north end of parapet northeast corner of bridge over the Elochoman River, approximate river mile 4.2.

EXHIBIT 3 - ELEVATION REFERENCE MARKS (Cont'd)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 24	39.120	Set brass screw leaded into drill hole in southeast corner of landing at the top of concrete steps of the Elochoman Grange #426 building, approximately 0.2 mile southwest of the intersection of State Highway 407 and Crown Zellerbach Logging Road (old railroad grade), point is approximately 0.6 foot west of the east edge of landing adjacent to a 4- x 4-inch post supporting the porch cover.
RM 25	20.223	A COE standard triangulation station disk, stamped "Z 309 1939." Approximately 2.7 miles south along old State Highway 12C from Rosburg, in northwest quarter of southeast quarter, Section 33, T10N, R8W, approximately 160 feet southeast of intersection of a dike road, about 158 feet southwest of highway, about 75 feet east of a house, 25 feet southeast of a curve sign, near a witness post, and set in top of a concrete post.
RM 26	31.066	A COE standard triangulation station disk, stamped "Y 309 1939." Approximately 1.5 miles south along old State Highway 12C from Rosburg, in the northeast quarter of southwest quarter, Section 27, T10N, R8W, approximately 100 feet west of junction of road leading to a shingle mill, about 20 feet north of the side road, near a witness sign, and set in top of a concrete post.